Repair of pars interarticularis defect using a U-shaped rod–screw construct

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Received 14 December 2010
Accepted 10 January 2011

Egyptian Orthopedic Journal 2012, 47:285–288

Study design
Retrospective study.
Aim
To evaluate the efficacy of pars repair using pedicle screws connected with a U-shaped rod in the treatment of traumatic pars defect of the lower lumbar spine after failed conservative treatment.
Materials and methods
Eighteen patients with traumatic pars defect were managed from 2004 to 2009 by pars repair using two pedicle screws inserted into the involved vertebra and connected by a U-shaped rod passing under a spinous process and tightened after careful defect debridement and grafting. An MRI was performed to exclude adjacent disc degeneration. The patients were followed up using plain radiographs, in anteroposterior, lateral and oblique views. A computed tomography scan was performed to ensure pars healing.
Results
All patients had bilateral traumatic pars defect; their ages ranged from 16 to 27 years. Follow-up ranged from 24 to 53 months. Fourteen patients showed improved symptoms and returned to activity with full range of motion by the end of the sixth postoperative month. Two patients developed radicular pain; one showed complete improvement in the seventh week, whereas the other required revision. Two patients showed pseudoarthrosis and persistent pain that required revision with posterior lumbar interbody fusion.
Conclusion
This technique is an easy, effective technique of short operative duration with the advantage of nonviolation of the neural canal, no requirement for postoperative bracing and safe return to activity by the end of the sixth month, with no requirement for further fusion.

Keywords:
bone scan, debridement, pars defect, pedicle

Egypt Orthop J 47:285–288
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1110 -1148

Introduction

Traumatic pars defect is frequently encountered in patients; usually, teenagers present with an acute lesion following significant hyperextension injury or compressive force to their lumbar spine, which is followed by the immediate and sudden onset of severe lower back pain. Radiographs reveal a fresh fracture of the pars interarticularis, and these patients have a very hot bone scan [1].

A wide spectrum of presentations exist in these young patients, ranging from an acute disabling episode of back pain to mild lower back discomfort when the patient engages in certain activities [2]. The back pain may be dominant to one side but more often is across the lumbosacral junction. Radiating leg pain is rare in spondylolysis, but hamstring tightness on straight leg raising is common. Neurologic symptoms and signs are usually absent [3].

The radiographic findings have no set pattern. Although most teenagers will have a defect that is seen on oblique radiographs, enough negative oblique radiographs occur to require additional radiologic investigations [4]. Additional investigative steps include a single photon emission computed tomography (SPECT) and a computed tomography (CT) scan. Experience has shown us that there is no common pattern to the findings in these three tests (oblique lumbar radiographs, SPECT scan, and CT scan) [5,6].

Conservative treatment in most patients is successful in controlling pain and helps gradual recovery and return to activities. Surgical treatment is rarely needed in patients who do not improve with adequate conservative treatment [7].

Materials and methods

Eighteen cases of traumatic spondylolysis were managed by pars repair, following failure of all lines of conservative measures; initially, all patients were treated with activity

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modification, full-time bracing with thoracolumbosacral orthosis and NSAIDs. Narcotic analgesics were added to this regimen, if indicated. Patients included in the study were those who showed no improvement after 6 weeks of treatment and adequate rest.

Diagnosis was made through history and clinical findings; all patients reported a history of sudden severe lower back pain after either sudden hyperextension trauma or axial loading of the lumbar spine due to falling in a sitting position. Three patients complained of radiating leg pain. Back pain was dominant on one side (two patients), and in most of the cases the pain extended across the lumbosacral junction. Pain during straight leg raising was positive bilaterally in all cases because of associated hamstring spasm. Other clinical features included postural changes, marked limitation of spinal range of motion, paravertebral muscle spasm and localized tenderness.

Radiological examination included radiographs in anteroposterior, lateral, left and right oblique views (although they are not reliable tests for excluding pars fracture) [5]. A CT scan with orthogonal orientation of the beam can accurately detect the pars discontinuity (Fig. 1). We used a ^{99m}Tc scan in clinically suspicious cases with negative radiographs and CT scans. It reveals increased uptake (hot areas) and helps to exclude other adjacent levels of spondylolysis (Fig. 2). MRI was routinely performed to evaluate the intervertebral disc condition to select cases suitable for repair.

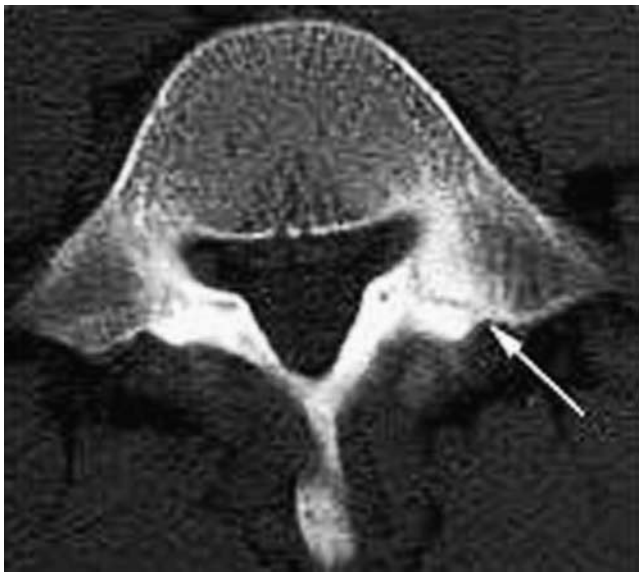
Eighteen cases were managed by pars interarticularis repair using a contoured U-shaped rod connecting two pedicle screws inserted in the pedicles at the affected level. The classic posterior approach was used taking care not to compromise the interspinous and supraspinous ligaments and preserving the facet joint capsules (Fig. 3).

The pars fracture was exposed and thoroughly debrided. We used high-speed burr to freshen the fracture edges. Further deep debridement was performed manually using tiny angled curettes to ensure safety of the neural elements. The developed space is then packed with a single well-fitted cancellous iliac bone graft.

Bone graft was harvested from the iliac crest through a tiny 1 cm incision over the posterior iliac crest; the used graft was a completely cancellous core without a cortical element. The graft was refined according to the size of the defect and impacted at the space after complete debridement. The graft was then compressed by tightening the rod in an upward shifting position of the lamina.

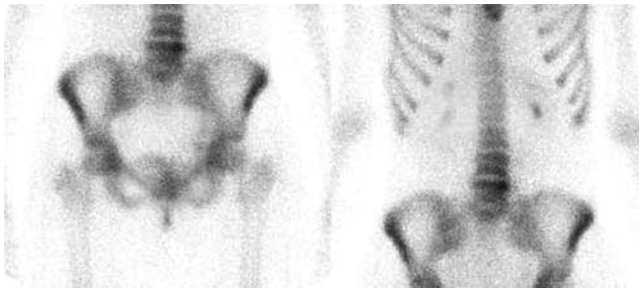
In all cases, top-loading polyaxial pedicle screws were inserted from a slightly lateral entry to avoid injury to the facet joints. The choice of these type of screws simplifies the insertion of a technically demanding acute contoured rod. After confirming the screw position by C-arm (Fig. 4), the rod was contoured in a 'U' shape taking care to use a malleable template to accurately fit the screws with suitable curve fitting just under the spinous process of the affected level. The rod was inserted to compress the graft within the defect (Fig. 5).

Figure 1



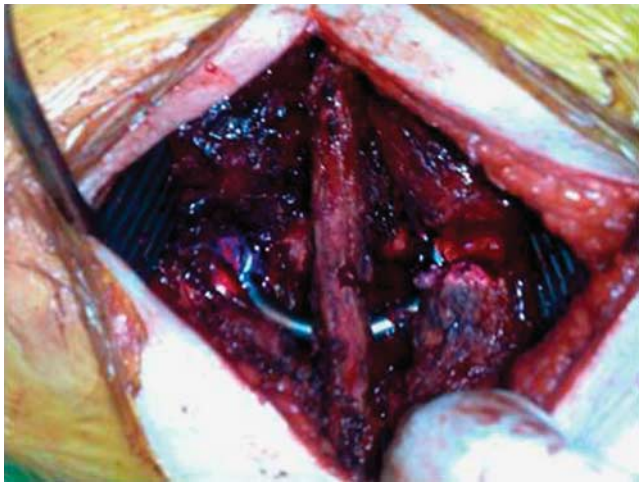
Computed tomography appearance of a pars fracture with orthogonal orientation of the beam (arrow).

Figure 2



^{99m}Tc bone scan with an active spot over an L5 pars interarticularis.

Figure 3



Intraoperative picture of the U-shaped rod passing through the interspinous space nonviolating the integrity of the ligaments.

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Figure 4

Lateral C-arm projection showing inserted pedicle screws inserted and assembled U-shaped rod.

Patients were discharged from the hospital by the third postoperative day (hospital stay was 48 h in all patients). No braces were applied in any of the cases. They were allowed to ambulate as long as the patients could tolerate pain. The patients were followed up in the first postoperative week to reassure them and examine the wound. Thereafter, follow-up was carried out at the rate of 1/month for 6 months, then yearly for 4 years.

Follow-up included a clinical examination and a radiological evaluation by plain radiographs in anteroposterior, lateral and oblique views. A CT scan was performed for all patients on the second and sixth month and at the end of the follow-up period.

Patients were instructed not to consume NSAIDs except paracetamol 500 mg on demand to avoid compromising the healing process. Postural exercises started after the first week. Returning to normal activities was advised after the sixth week and scheduled protocol for sport activities was arranged with a physiotherapist in the sixth month [7,8].

Results

All patients had traumatic pars defect. Eighteen patients had bilateral pars defect; 15 patients had L5 pars fracture; and three patients had L4 pars fracture. The patients' ages ranged from 16 to 27 years. The mean age was 23.73 years. The follow-up period ranged from 24 to 53 months with a mean follow-up period of 42.3 months.

Blood loss ranged between 150 and 520 ml; mean blood loss was 342.3 ml. Mean operative time was 67 min. All patients were discharged after 48 h of hospital stay.

Fourteen cases showed gradually improving back pain after the procedure until complete improvement by the third month. Preoperative Oswestry scores ranged from 50 to 74. The postoperative score at the end of the third month was 90–100. Two patients developed postoperative radicular pain that improved gradually. One of them showed complete improvement by the seventh postoperative week, whereas the other required revision surgery by decompression and fusion with posterior lumbar interbody fusion. Two patients showed no evidence of union and required posterior lumbar interbody fusion.

Discussion

Several surgical techniques have been described for surgical repair of symptomatic spondylolysis and up to grade 1 spondylolisthesis refractory to conservative management. Multiple wires, screws, and screw–wire, pedicle screw–wire, pedicle screw–hook and pedicle screw–rod constructs have been described with a high rate of good to excellent results [9–11].

These techniques are technically difficult and some require wires, hooks or cable passage beneath the lamina or the transverse process. There has been occasional loss of fixation with broken wires and increased risk for nerve injury during blind passage of sublaminar cables [10].

Using a U-shaped rod has the advantage of using a stronger material with less breakage and lower potential for neurologic complications related to wire passage beneath the transverse process or lamina, decreasing the degree of technical difficulty.

We have results that are comparable to those in the literature. In a study by Satumi *et al.* [12] comprising 13 patients with isthmic spondylolisthesis he used segmental wires and bone grafting of pars defect; 90% of his patients showed solid union and good to excellent results, yet with longer operative time: 201 min (range, 125–320 min) compared with 67 min (range 55–75 min).

A modified Songer cable technique was used around the spinous process, which has the disadvantage of using cables that carry higher rate of cutting through and implant failure compared with the contoured rod.

Conclusion

This technique has been proven to be an easy and effective technique for pars repair with a relatively short operative time. It has the advantage of nonviolating the

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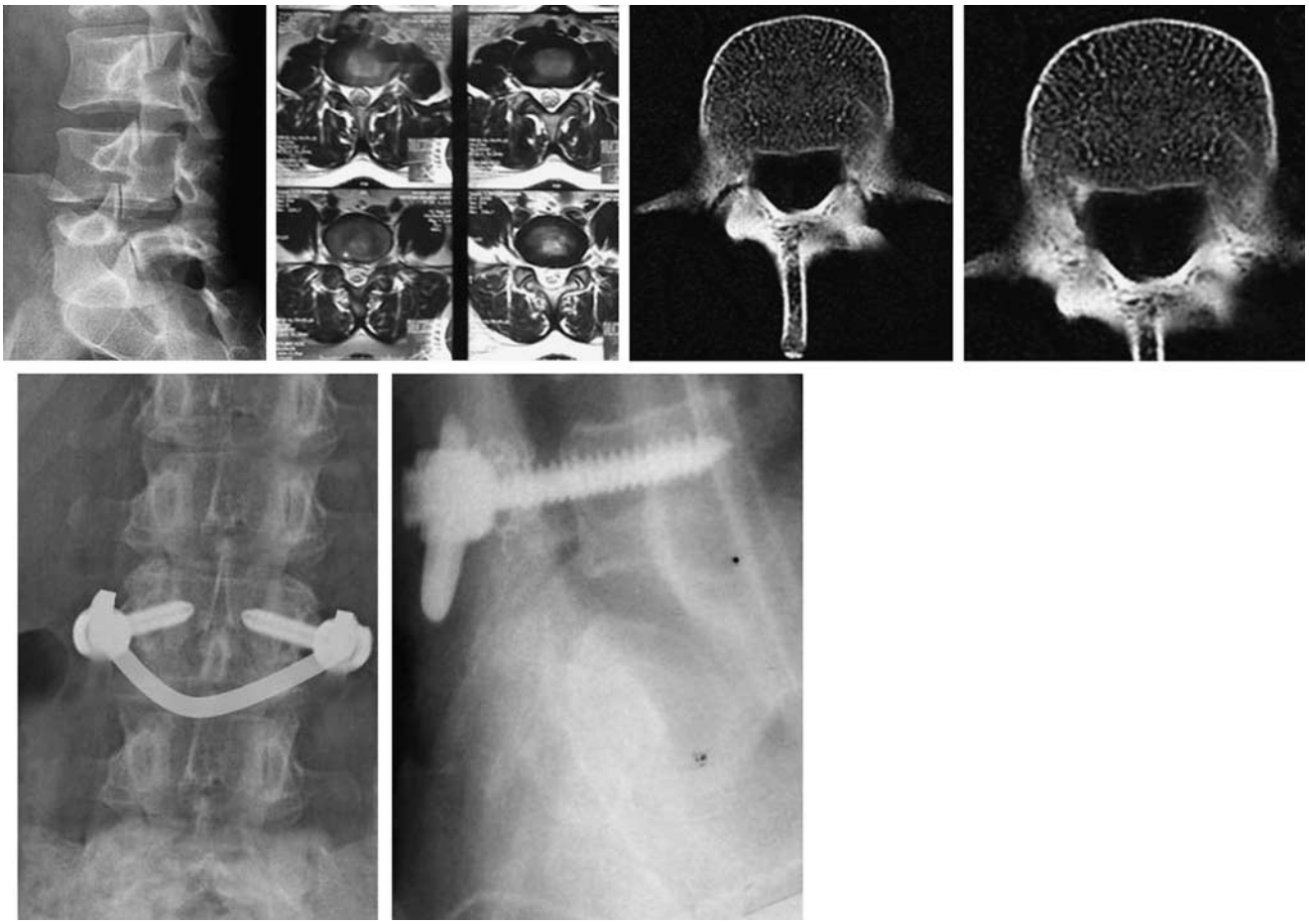
Figure 5



A case of traumatic spondylolysis with an oblique view showing interruption of the pars interarticularis, MRI showing intact discs, computed tomography orthogonal view with defect seen before and after healing, anteroposterior and lateral radiographs with a U-shaped rod.

neural canal, not having a requirement for postoperative bracing and enabling patients to safely return to activity by the end of the sixth month.

Acknowledgements

Conflicts of interest

There are no conflicts of interest.

References

1 Beutler WJ, Fredrickson BE, Murtland A, Sweeney CA, Grant WD, Baker D. The natural history of spondylolysis and spondylolisthesis: 45-year follow-up evaluation. Spine 2003; 28:1027–1035.

2 Bono CM. Current concepts review: low-back pain in athletes. J Bone Joint Surg Am 2004; 86:382–396.

3 Dreisinger TE, Nelson B. Management of back pain in athletes. Sports Med 1996; 21:313–320.

4 Herman MJ, Pizzutillo PD. Spondylolysis and spondylolisthesis in the child and adolescent: a new classification. Clin Orthop Relat Res 2005; 434:46–54.

5 Lusins JO, Elting JJ, Cicoria AD, Goldsmith SJ. SPECT evaluation of lumbar spondylolysis and spondylolisthesis. Spine 1994; 19:608–612.

6 Read MTF. Single photon emission computed tomography (SPECT) scanning for adolescent back pain. A sine qua non? Br J Sports Med 1994; 28:56–57.

7 Nozawa S, Shimizu K, Miyamoto K, Tanaka M. Repair of pars interarticularis defect by segmental wire fixation in young athletes with spondylolysis. Am J Sports Med 2003; 31:359–364.

8 Iwamoto J, Takeda T, Wakano K. Returning athletes with severe low back pain and spondylolysis to original sporting activities with conservative treatment. Scand J Med Sci Sports 2004; 14:346–351.

9 Gillet P, Petit M. Direct repair of spondylolysis without spondylolisthesis, using a rod–screw construct and bone grafting of the pars defect. Spine 1999; 24:1252–1256.

10 Bozarth GR, Fogel GR, Toohey JS, Neidre A. Repair of pars interarticularis defect with a modified cable-screw construct. J Surg Orthop Adv 2007; 16:79–83.

11 Henderson ED. Results of the surgical treatment of spondylolisthesis. J Bone Joint Surg Am 1966; 48:619–642.

12 Satomi K, Ogawa J, Hoshi T, Kawai D, Sugihara S, Ishii Y. Pedicular screw and segmental wire fixation for repair of the pars defect of spondylolysis. J Orthop Surg 1998; 6:47–52.

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